

The preceding specific embodiments are illustrative of the practice of the invention. It is to be understood, however, that other expedients known to those skilled in the art, or disclosed herein, may be employed without departing from the spirit of the invention or the scope of the appended claims.

We Claim:

1. A process to prepare stoichiometric-nanostructured materials comprising:
generating a plasma;
forming an "active volume" through introduction of an oxidizing gas into the plasma, before the plasma is expanded into a field-free zone, either (1) in a region in close proximity to a zone of charge carrier generation, or (2) in a region of current conduction between field generating elements, including the surface of the field generation elements; and
transferring energy from the plasma to a precursor material or materials and forming in the "active volume" at least one of stoichiometric-nanostructured materials and a vapor that may be condensed to form a stoichiometric-nanostructured material.
2. The process of claim 1, wherein the step of generating comprises utilizing a radio-frequency field to generate the plasma.
3. The process of claim 1, wherein the step of generating comprises utilizing a microwave discharge to generate the plasma.
4. The process of claim 1, wherein the step of generating comprises utilizing a free-burning electric arc to generate the plasma.
5. The process of claim 1, wherein the step of generating comprises utilizing a transferred electric arc to generate the plasma.

6. The process of claim 1, wherein the step of generating comprises utilizing a high-intensity laser to generate the plasma.
7. The process of claim 1, wherein the step of generating comprises utilizing a capacitively coupled electro-thermal igniter to generate the plasma.
8. The process of claim 1, wherein the step of generating comprises utilizing a DC glow discharge to generate the plasma.
9. The process of claim 1, wherein the step of generating comprises utilizing a DC cold cathode discharge to generate the plasma.
10. The process of claim 1, wherein the step of forming comprises selecting the oxidizing gas from one of a gas containing oxygen atoms or a gas mixture containing oxygen atoms.
11. The process of claim 1, wherein the step of forming comprises selecting non-oxygen components of the oxidizing gas from a group comprising He, Ne, Ar, Kr, Xe, N₂, and H₂, or mixtures thereof.
12. The process of claim 1, wherein the step of forming comprises selecting N₂O as the oxidizing gas.
13. The process of claim 1, wherein the step of forming comprises selecting O₂ as the oxidizing gas.
14. The process of claim 1, wherein the step of forming comprises selecting CO₂ as the oxidizing gas.
15. The process of claim 1, wherein the step of forming comprises introducing the oxidizing gas into an anodic column of a transferred electric arc.

16. The process of claim 1, wherein the step of forming comprises introducing the oxidizing gas into a cathodic column of a transferred electric arc.
17. The process of claim 1, wherein the step of forming comprises introducing the oxidizing gas into a anodic column of a free-burning electric arc.
18. The process of claim 1, wherein the step of forming comprises introducing the oxidizing gas into a cathodic column of a free-burning electric arc.
19. The process of claim 1, wherein the step of forming comprises introducing the oxidizing gas to the plasma by natural convection.
20. The process of claim 1, wherein the step of forming comprises introducing the oxidizing gas to the plasma by forced convection.
21. The process of claim 1, wherein the step of forming comprises allowing the oxidizing gas to atomize a liquid nanoparticle precursor and introduce it into the "active volume".
22. The process of claim 1, wherein the step of forming comprises allowing the oxidizing gas to fluidize and transport a solid nanoparticle precursor into the "active volume".
23. The process of claim 1, further comprising:
Injecting at least one of a quench and dilution stream just beyond the "active volume." The injection point beyond the "active volume" is from one mean free path of a plasma species to a larger distance deemed to be appropriate to quench the vapor and is generally determined by process equipment configuration.
24. The process of claim 23, wherein the step of injecting comprises creating a nanoparticle aerosol of controlled particle size.

25. Stoichiometric-nanostructured materials produced through steps comprising:
generating a plasma;
forming an “active volume” through introduction of an oxidizing gas into the plasma, before the plasma is expanded into a field free zone, in a region in close proximity to either (1) a zone of charge carrier generation, or (2) a region of current conduction between field generating elements, including the surface of the field generating electrodes; and
transferring energy from the plasma to a precursor material or materials and forming in the “active volume” at least one of stoichiometric-nanostructured materials and a vapor that may be condensed to form a stoichiometric-nanostructured material.
26. The stoichiometric-nanostructured materials of claim 25, wherein the stoichiometric-nanostructured materials are metal oxides.
27. The stoichiometric-nanostructured materials of claim 25, wherein the stoichiometric-nanostructured materials are substantially spherical nanocrystalline metal oxides.
28. The stoichiometric-nanostructured materials of claim 26, wherein the metal oxides are selected from a group comprising aluminum oxide, zinc oxide, iron oxide, cerium oxide, chromium oxide, antimony tin oxide, mixed rare earth oxides, and indium tin oxide.
29. The stoichiometric-nanostructured materials of claim 25, wherein the stoichiometric-nanostructured materials generally have a size distribution and range in mean diameter from about 1 nm to about 900 nm.
30. The stoichiometric-nanostructured materials of claim 29, wherein the stoichiometric-nanostructured materials generally have a size distribution and range in mean diameter from about 2 nm to about 100 nm.

31. The stoichiometric-nanostructured materials of claim 30, wherein the stoichiometric-nanostructured materials generally have a size distribution and range in mean diameter from about 5 nm to about 40 nm.
32. The stoichiometric-nanostructured materials of claim 25, wherein the stoichiometric-nanostructured materials have a surface chemistry having a high aqueous dispersion stability.
33. The stoichiometric-nanostructured materials of claim 25, wherein the stoichiometric-nanostructured materials have a surface chemistry having a low rate of hydrolysis.
34. The stoichiometric-nanostructured materials of claim 25, wherein the stoichiometric-nanostructured materials have a surface chemistry with the absolute value of the zeta potential greater than 20 mV.
35. The stoichiometric-nanostructured materials of claim 34, wherein the stoichiometric-nanostructured materials have a surface chemistry with the absolute value of the zeta potential greater than 30 mV.
36. The stoichiometric-nanostructured materials of claim 35, wherein the stoichiometric-nanostructured materials have a surface chemistry with the absolute value of the zeta potential greater than 35 mV.